ATMS Case Study

Background

Several years ago, the State of Lincoln's Department of Transportation (LDOT) determined that it required an advanced transportation management system (ATMS) to control traffic in the busy corridor connecting its two largest cities – Grant and Lee. They selected a system manager to implement the project. The system manager was to:

- Prepare a functional description of the ATMS system based on interviews with State personnel and the system manager's expertise with similar systems
- Develop specifications and cost estimates for the system hardware and construction services, all of which was to be purchased by LDOT on a low bid basis
- Provide all software and system integration services required for the implementation of a fully functional traffic management system
- Develop system acceptance test procedures

The system was to be capable of providing all of the surveillance and control functions typically provided in a modern traffic management system including detector data processing, traffic signal control, and control of field devices including variable message signs, CCTV camera controls, and highway advisory radio.

History of the Project

The project began with the selection of a systems manager using LDOT's normal consultant selection process for a two-phase project. During the first phase, the functional description and specifications would be prepared. On the basis of this work, a second phase would be negotiated for the implementation of the system that had been defined during the first phase.

A defense contractor (Huge Electrical and Electronics Productions, Inc. – also known as HEEP) was selected as system integrator, because of their knowledge of the latest system development technology. To ensure the availability of adequate freeway management experience, HEEP subcontracted with a local traffic-engineering firm (Xerxes, Young and Zbignew, Inc. – also known as XYZ).

Phase I Activities: During phase I of the project, HEEP and XYZ worked diligently to prepare the needed functional description and specifications. HEEP and XYZ met with all of the LDOT personnel likely to be involved in the application of the ATMS system and supplemented this information with state-of-the-art reviews of the latest technology. This work served as the basis for an extensive set of documentation on which the Phase II activities were to be based.

HEEP had assigned one of their best project managers to the LDOT project and was proud of their work. They felt that the system design would meet the State's requirements for a long time into the future. HEEP had carefully followed the procedures suggested by the FHWA National

ITS System Architecture, to ensure that future requirements to interface with other State agencies had been taken into account. The State had also invited local agencies to attend their ATMS coordination meetings. However, the locals elected not to participate, since the ATMS project was primarily concerned with freeway operations and did not appear to offer any new sources of funding for their activities.

LDOT personnel were generally satisfied with HEEP's work and found HEEP personnel to be very accommodating during the system definition and specification process. Some misgivings occurred during the Phase II negotiations, when it became apparent that HEEP's cost estimate for the systems integration and software development would exceed LDOT's budget by nearly 100%.

Phase II Activities: Phase II negotiations were not pleasant. However, both LDOT and HEEP were committed to the project, and neither could consider backing out. The result of the negotiations were that LDOT had to reduce the desired system functionality and HEEP eliminated their contingency budget and reduced their project management budget. Both organizations were worried about the project.

Because of the duration of the Phase II negotiations and the period required to finalize the contract, HEEP received their notice to proceed approximately six months later than anticipated. As a result, the publicized project schedule was badly out of date and project management personnel from both organizations were under pressure to accelerate their work.

In spite of the slow start, HEEP and LDOT gradually began making progress. LDOT released HEEP's specifications for bid to equipment suppliers and contractors. HEEP gradually completed the software design and assigned programmers to begin coding.

As work progressed, LDOT became aware of the fact that certain aspects of the specifications required further "clarification". For example:

- The signal control interface was to include control of LDOT's closed loop systems, all of which were the same make and model. However during the course of the ATMS development, a decision was made to replace one of the systems with a new model. The new system required a different interface.

- The variable message signs acquired by the State included new features that were not in existence when the specifications were originally prepared. Significant enhancements would be required to the ATMS drivers.

- The planning department became concerned that detector data would not be stored in a readily accessible format. They asked HEEP to provide the capability to export data directly into a spreadsheet.

LDOT and HEEP negotiated the impact of each of these changes. In all cases compromises were made or the implementation of the change was deferred to the future. Specifically, the State agreed to defer the interface with the new closed loop system even though it significantly reduced their incident management capabilities. HEEP agreed to incorporate the new VMS features. The planning department's needs were to be satisfied through the creation of predefined database queries that would retrieve the needed data.

A New Consideration

The ATMS development is continuing. LDOT has received a telephone call from the traffic engineer of Meade County, the county within which the system is being installed. The county has decided to purchase a new signal system, and would like to integrate the system with the State's system. LDOT personnel are delighted. This request meets the intent of the National Architecture that systems within a region be fully integrated. In addition, this new request represents a wonderful opportunity to develop closer relationships with Meade County.

The Problem

In this role playing activity, four individuals will be selected from the class. They will play the following roles:

From LDOT: One individual will play the role of the LDOT project manager
A second individual will play the role of the LDOT technical expert

From HEEP: One individual will play the role of the HEEP project manager
A second individual will play the role of the HEEP chief programmer

The problem to be solved is that HEEP and LDOT must reach agreement on the inclusion of the Meade County signal systems as part of the LDOT ATMS.

Instructions for LDOT Project Manager Role

The general description provided to the class is an accurate description of the project. However, it fails to capture the frustration that you have felt with this project.

During project phase I, you felt that HEEP generally performed conscientiously. However, you were frustrated by the fact that they failed to utilize XYZ's services as they had promised in the proposal. XYZ personnel rarely showed up at project meetings, and those that did knew little about ATMS technology. As a result, you feel that HEEP focused on information technology, and showed little interest in traffic management. As a result, you feel that any "minor" changes in scope that occur during phase II of the project are a result of HEEP's inattention to the traffic management functions of the system.

You are also somewhat resentful of the high cost estimate that HEEP provided for the Phase II work. You feel that this estimate was padded, and that they were trying to make up for prior losses on other projects at LDOT's expense. As a result, of the negotiations, valuable functionality was abandoned, much to your embarrassment.

The slow start on Phase II was inexcusable. While it's true that the negotiations and processing of the agreement took some time, HEEP was not ready to begin work at the time that they received their notice to proceed. There was no evidence of serious progress on the project for many months after Phase II finally began.

In spite of everyone's best efforts, relationships have continued to deteriorate during Phase II. Every change that has been requested has been resisted by HEEP, no matter how trivial it seems to be. You feel that you are a victim to their big company culture, which is used to dealing with the Department of Defense with its unlimited resources.

Resistance by HEEP to this latest change would be unacceptable. Including Meade County on this project is extremely important to your management and to your future career at LDOT. This simple change increases the total number of controlled intersections by only 15%, and would have no impact on the system's functionality, since the County's signals are controlled by a closed loop system that is the same make and model as the State's signals for which an interface is already being developed. You also feel that the intent of the specifications, which require readily expandable capability, adequately covers the requirement to add Meade County to the system. You are determined not to let HEEP walk all over you again.

You like the HEEP personnel with whom you are negotiating, and feel that the company has placed them in an awkward position. You have a high level of confidence in the LDOT technical expert who is advising you on this project.

Instructions for LDOT Technical Expert Role

The general description provided to the class is an accurate description of the project. However, it fails to capture the frustration that you have felt with this project.

During project phase I, you felt that HEEP generally performed conscientiously. You admired their grasp of information technology, and enjoyed working with them. Although you heard some complaint about HEEP's lack of interest in traffic management, you were much more interested in the overall system architecture, and the equipment specifications developed during the project

You were embarrassed by the high cost estimate that HEEP provided for the Phase II work. You had been asked to develop a preliminary estimate for the department, and had missed the mark by 100%. You felt that HEEP was getting rich at LDOT's expense, and you resented it. You are also jealous of the high salaries HEEP pays its programmers and other technical staff. You feel that your job entails significantly higher levels of responsibility, and your compensation is much lower. The primary difference between HEEP's estimates and yours were the results of the unexpectedly high salaries and excessive management time applied to the project.

You are really getting tired of HEEP's negative reaction to every single change that is requested. You feel that it was their responsibility to have figured out the required functionality in the first place. So most of the required changes are the result of their oversights during Phase I. You are feel VERY STRONGLY that most of these changes are already within the scope of the system functional description, and that HEEP is taking LDOT to the cleaners by charging for every reinterpretation of this description. For example, the requirement to interface with new VMS features had already been covered by the requirement in the specification that HEEP provide communications drivers capable of interfacing with all the features of the selected VMS. Yet LDOT "caved into" HEEP's insistence that this should not be considered a requirement of the existing contract.

You are determined that this negotiation will be successful. You are determined both because you recognize the importance of the Meade County integration to your organization, and because you do not want to be embarrassed by HEEP again.

You have carefully reviewed the specifications and determined that HEEP is responsible for interfacing with several (quantity not specified) closed loop signal systems. This simple change increases the total number of controlled intersections by only 15%, and would have no impact on the system's functionality, since the County's signals are controlled by a closed loop system that is the same make and model as the State's signals for which an interface is already being developed. Thus you feel that the intent of the specifications, which require readily expandable capability, adequately covers the requirement to add Meade County to the system.

Instructions for HEEP Project Manager Role

The general description provided to the class is an accurate description of the project. However, it fails to capture the frustration that you have felt with this project.

The ITS unit of HEEP is a relatively new organization, that is yet to prove itself to the corporation. To date, HEEP-ITS has provided systems integration services for three ATMS projects, and none of these projects has been profitable. You suspect that your future, and the future of HEEP-ITS depends on the profitability of the LDOT project.

Phase I of the project has progressed satisfactorily. Relationships with XYZ were somewhat frustrating, in that they wanted to have direct contact with LDOT personnel, an approach that was unheard of in Department of Defense contracts. Although XYZ personnel had good personal relationships with LDOT staff, they knew very little about ATMS technology. As a result, their participation in the project was minimized.

The carefully developed Phase II cost estimate proved to be unacceptable to LDOT, who failed to appreciate the need for contingency funding in order to account for unanticipated changes in project scope. In addition, LDOT refused to compensate HEEP for their project management costs, because of their failure to understand the value of a well-managed project. After extensive internal discussions, HEEP-ITS decided to agree with LDOT demands to lower their charges for the Phase II work, providing you managed the project carefully and avoided scope creep.

In spite of your best efforts, you have been forced to make some expensive concessions. In addition, there have been numerous problems including:

- Because of LDOT's delays in initiating Phase II, the software staff identified for this project were assigned to other work. As a result, it was necessary to recruit additional programmers, a time consuming and expensive process that delayed the start of work.
- In some cases, low-bid equipment procured by LDOT was accepted when it failed to meet the specifications. HEEP was required to solve the resulting interface problems.
- The changes in requirements have lead to three software redesigns. The software is now under development. Any future changes will be prohibitively expensive.

Now, LDOT is asking for another change. Your chief programmer tells you that this change will affect the hardware configuration as well as the database structure and the graphics design. It will also require new system security procedures to define the control and monitoring responsibilities of the two agencies. In short, this is a change that cannot be accommodated without project delays as long as two years and $1 million of extra cost. This is well beyond the intent of the specification requirement for an expandable capability, which you have met by readily accommodating additional signal devices as they are added to the LDOT network within the current geographic scope of the system.

Instructions for HEEP Chief Programmer Role

The general description provided to the class is an accurate description of the project. However, it fails to capture the frustration that you have felt with this project.

You would like this project to succeed both because of your professional pride, and the possibility that you LDOT might be a future customer of yours in some other business.

You have studied the proposal to add the Meade County signal system to the LDOT ATMS and you are horrified that anyone would consider this a trivial change. The work associated with such a change is extensive. Yet you recognize the difficulty of explaining this to the State, whose only "technical expert" whose prior experience was limited to the development of accounting systems software.

The specification requirement for an expandable capability was met by readily accommodating additional signal devices as they are added to the LDOT network within the current geographic scope of the system. However, the known changes needed for Meade County's signal system go well beyond the intent of that requirement and include:

- Significant addition of graphics to the graphical user interface (GUI) which has already been completed.

- Change in range of zoom levels required by the GUI in order to display the closely spaced city streets controlled by Meade County.

- Significant expansion of the database to accommodate 400 additional signals and 800 additional detectors.

- Significant expansion of the GIS to accommodate the expanded geographic scope and the arterial road network in Meade County.

- The need for additional communications ports and processors to handle the increased input output load of the system.

- Modification of all reports to accommodate the new equipment

- Review and modification of numbering systems (which had originally been based on the State's location and equipment numbering system).

- Modification of security restrictions because two separate organizations would now have the ability to control and monitor each other's equipment.

And these are only the known changes. Who knows how many additional changes will be identified when the work begins. Your guess is that this work will add over $1 million to the cost of the system, and could delay its implementation by about two years.